

# AN ENERGY POLICY FOR CANADA

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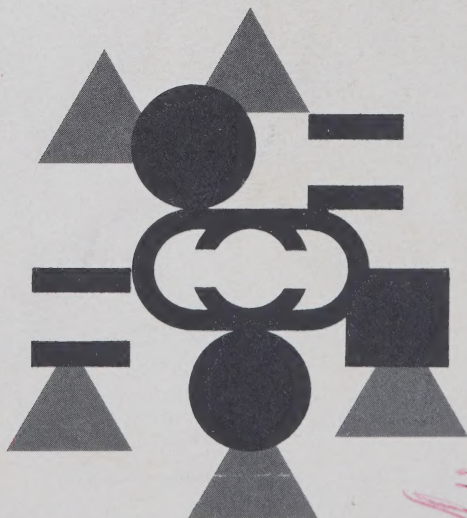



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PHASE 1 - ANALYSIS

SUMMARY OF ANALYSIS

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# AN ENERGY POLICY FOR CANADA

Phase 1 — ANALYSIS

## SUMMARY OF ANALYSIS

Issued under the authority of  
The MINISTER of ENERGY, MINES and RESOURCES  
Ottawa, Canada

# AN ENERGY POLICY FOR CANADA

Part I - ANALYSIS

STATEMENT OF ANALYSIS

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## FOREWORD

Energy, how it is to be obtained and how used, has emerged as one of the major public questions of our time. With the growing complexity of the industrial economy, and increasing aspirations for a better life, the rate of demand for energy has been accelerating.

Because the sources of energy now employed are known to be finite, and in face of the increased demands on them, grave concern has grown up as to whether future supplies will be available, and available at a cost that will not negate our other aspirations. Grave concern has also emerged about the effect on the natural environment of present methods of acquiring, transporting and using energy sources.

The attainment of many of our national goals is dependent on our continued access to low-cost supplies of energy: the growth in our standards of living, as individuals and as nations; the improvement in the quality of life, in the choices available to us.

At the international level we have heard expressions of concern about the availability and cost of energy in the future. In Canada we have had the good fortune to be endowed with substantial supplies of all five main sources of energy: coal, oil and gas, hydro power and uranium. But with our climate, and with the transportation demands imposed on us by our vast land-area, our demand for energy is also substantial.

We in Canada are now on the threshold of some major discussions in the energy field. We must soon decide at what rate we are to develop our frontier sources of oil and gas, with all the implications that such development has for the lives of those that make their homes in those regions, for the environment of those areas and for the national economy.

Most of the major, accessible sources of hydroelectric potential have been, or are now being, harnessed. We must make decisions as to what form of thermal generation, fossil fuel or nuclear, is to meet the future demand for electric power.

To prepare for future challenges in the energy field we must get underway now scientific research and the development of technology. Decisions now as to how we employ our finite research and development resources will determine the ability to respond to the problems that will affect coming generations.

During the time that the studies reported on by this document have been underway, energy reports have been issued by the provinces of British Columbia, Alberta, Ontario and Quebec. The purpose of this report is to define more clearly the national framework into which provincial studies fit, to identify policy choices which must be made within the federal jurisdiction, and to provide a basis for choice by the Government and people of Canada.

The next step is one of consultation. Consultation with members of the public interested in the various facets of the energy question and with governments of the provinces. On the basis of the information which this report provides as to where we are, and where the various choices may lead us, and following those consultations, the Government of Canada will then reach the second phase of its approach to the energy problem of deciding how, and with what instruments our existing energy policies should be altered.

HON. D. S. MACDONALD

## INTRODUCTION

Canadians use more energy on a per capita basis than any nation of the world other than the United States. About one quarter of our disposable income is used to purchase and operate equipment to provide heat, light and transportation.

This heavy reliance on energy in every aspect of our daily life makes energy policy everybody's concern. As individuals we have strong views on such matters as pollution, pipelines, native claims, export controls, etc.—all directly related with the need for and use of energy. Nearly every Canadian feels the country's energy policy affects him personally. We are not content to leave its development entirely to government or to the actions of free market. Today Canadians insist on participating in determining how Canada's energy resources will serve them.

Our energy policies must cope with the fact that nature has frequently placed major Canadian energy resources in rather inconvenient places in relation to where energy is needed and used. In building Canada provincial boundaries were selected without regard to water or other resource distribution. It is not unnatural that, for example, the residents of Alberta may feel very differently about the price of natural gas than do those of Ontario. Each can argue that their position leads to the public benefit. Much of the strength and character of Canada lies in these differences and the factors that give rise to them. Satisfactory energy policies must find a consistent yet flexible method of operation that will serve both national and regional interests.

There is a need for guidelines for federal and provincial activities. Energy policies must also reflect the needs and interests of the municipalities which facilitate the use of much of the nation's energy, private business which is dominantly responsible for producing and marketing energy, and the consumer who must derive a benefit from the total operation.

This summary report has been excerpted from the main document entitled "An Energy Policy for Canada, Phase 1—Analysis" and was prepared with the objective of presenting to the people of Canada in summary form the results of continuing studies of key elements which lead to the development of energy policies. It is hoped that this report and the main document will help in establishing a sound basis for an informed public debate of all of the issues. The studies upon which the report is based are being improved as the basic data are refined. They represent the best analyses available at this time in a rapidly changing scene. Policy decisions, however, must be made on the basis of a knowledge base existing at any one point in time. This report and the main document, coupled with information which will now flow in response from the provinces, the energy industries and the general public, represent that base.

Having had the benefit of such a response, it is proposed that a second report be prepared setting forth the major issues existing in the energy field together with policy recommendations to deal with them to best benefit Canada.

The procedure in carrying out the program of energy policy studies during the past two years has been to encourage participation by any agency of government having responsibilities bearing on energy policy. This ensures consideration of relevant matters from all points of view. Some specialized studies were commissioned to consultants. These reports were used as sources of information or expert opinion where they were not otherwise available within government. The project has been coordinated by the Department of Energy, Mines and Resources where much of the analytical work and writing has been done with the help from members of the staff of the National Energy Board, Atomic Energy of Canada Ltd., the Atomic Energy Control Board and Eldorado Nuclear Ltd.

## SUMMARY OF ANALYSIS

Energy in Canada is a highly complex subject. No single summary document can hope to deal with all of the complexities and interrelationships involving such facets as balance of payments, capital markets, employment, the environment, regional impact, resource development and economic growth—quality of life. Thus, a summary report of this nature runs the danger of being misleading or incomplete. Accordingly, the reader is cautioned that the following Summary of Analysis should be read in conjunction with the main body of the text and the appendices which set forth the various assumptions made and areas of deficiency in data or analysis.

With this expression of caution, here are the main findings of the studies.

### ENERGY AND THE QUALITY OF LIFE IN CANADA

Canadians are heavy users of energy. Our per capita use of energy is the second highest of any nation in the world. On the average, each of us uses each year energy equivalent to that contained in 55 barrels of oil. Much of this energy is required to achieve a reasonable material standard of living in Canada, but an important part also goes to enable Canadians to enjoy, by choice, the life style and the activities that they find satisfying. Our aspirations and concepts of desirable life styles are continually changing, but improvements in the quality of our lives are not likely to be accompanied by a future reduction in the net per capita use of energy. To a large degree the quality of life enjoyed by Canadians is, and will continue to be, determined by how we employ energy not needed for our basic material existence.

Although adequate energy is essential to a high quality of life, an increase in the use of energy will not necessarily lead to improvement in the quality of life. Improvement may depend largely on having a range of choices available, and on the ability to make choices with a balanced perspective of immediate and long-term consequences. Our energy policies play an important role in enabling Canadians to have adequate energy for their needs, and in directing its use towards attainment of the objective of a satisfactory and improving quality of life.

### A QUARTER CENTURY OF DEVELOPMENT

Primary energy consumption in Canada has tripled during the past 25 years. Oil and gas now meet almost two thirds of total energy consumption compared with less than one quarter 25 years ago, while coal's share has declined from one half to one tenth. The other major energy source is hydroelectricity which has been meeting about one quarter of total energy needs since the late 1950's. Nuclear energy has yet to make a significant impact on the total national scene.

The growth of the energy industries during the past 25 years has now established them as a major component of the Canadian economy with a primary production

value in 1972 of \$5 billion. In that year, energy trade had a favourable balance of \$634 million compared with a deficit of \$300 million in 1960. They continue to be major growth industries and in 1972 accounted for almost one fifth of total capital investment in Canada. Their importance in regional development is indicated by the \$3.6 billion of oil and gas revenues that have accrued to the Alberta Government since 1947 and by the industrial development that has been stimulated in Western Canada. Other elements of growth relate to the 6.7 per cent average annual increase in the demand for electricity, which has been considerably above the average annual increase in total energy demand of 4.3 per cent.

### THE ENERGY INDUSTRIES—WHAT THEY ARE

In 1972 the oil industry produced 1.7 million barrels of crude oil daily, exported 1.1 million barrels of crude and products and imported 900,000 barrels daily of crude and products. Production in 1962 was just over 0.7 million barrels per day (see Table 1); thus the producing rate has more than doubled in a decade. The potential oil resource base appears to be large, but the recent rapid production increase has led to a decline in the proved reserves to annual production ratio from 24.5 to 15 in the period 1966-1972. Export controls were placed on oil in March of 1973. As the resource base in the Prairie Provinces is now largely delineated, exploration is being conducted in the frontier areas of the far north and offshore and more active development is commencing in the Athabasca oil sands area. Rising world prices are serving to stimulate this new phase in Canadian oil development.

The natural gas industry in 1972 produced 2,500 billion cubic feet compared to 900 billion cubic feet in 1962 and exported 1,000 billion cubic feet (340 billion cubic feet in 1962—see Table 2). As in the case of oil, the potential resource base appears large but new reserves must be developed for the domestic market before there can be any further growth in exports. Annual reserve additions will have to increase substantially from the 1970 increase of 2,800 billion cubic feet if they are to support a pipeline for the transport of Arctic reserves. As the natural gas industry enters a new phase of expansion based on production from frontier areas, the effect of price increases will become increasingly acute.

TABLE 1  
OIL SUPPLY AND DEMAND  
(in thousands of barrels/day)

	1962	1972 <sup>e</sup>
Domestic demand . . . . .	938	1,589
Exports — crude oil . . . . .	236	951
— products . . . . .	16	193
Total demand . . . . .	1,190	2,733
Production — crude oil . . . . .	715	1,689
— gas plant LPG. . . . .	16	130
Imports — crude . . . . .	369	757
— products . . . . .	83	142
Total supply . . . . .	1,183	2,718
Inventory change . . . . .	-7	-15

<sup>e</sup> Estimated.

TABLE 2  
NATURAL GAS SUPPLY AND DEMAND  
(in billions of cubic feet/year)

	1962	1972 <sup>e</sup>
Domestic demand . . . . .	432	1,256
Exports . . . . .	343	1,012
Total demand . . . . .	775	2,268
Net production . . . . .	894	2,467
Marketable pipeline gas . . . . .	769	2,252
Imports . . . . .	6	16
Total supply . . . . .	775	2,268

<sup>e</sup> Estimated

In 1972 the coal industry produced 20.6 million tons of coal, exported 9.4 million tons of coal and 260 thousand tons of coke and imported 19.3 million tons of these products. Exports have risen markedly since 1969 and imports have increased by 50 per cent since 1962 (see Table 3). Canada's coal resource base is very large but much more information must be obtained as to its quality and mineability for purposes of determining future export policy and best use within Canada.

TABLE 3  
COAL AND COKE SUPPLY  
AND DEMAND  
(in thousands of short tons)

	1962	1972
Domestic demand.....	22,515	26,710
Exports — coal.....	894	9,421
— coke.....	131	263
Total demand.....	23,542	36,394
Production.....	10,217	20,638
Imports — coal.....	12,322	18,569
— coke.....	233	777
Total supply.....	22,772	39,984
Inventory change.....	-770	3,590

TABLE 4  
ELECTRICAL ENERGY IMPORTS  
AND EXPORTS  
(millions of kilowatt hours)

	1963	1967	1972
Canadian total net generation	122,238	165,625	238,568
Canadian exports to U.S.	3,613	3,994	10,372
Canadian imports from U.S.	2,884	4,181	2,440
Canadian net exports	729	-187	7,932
Net exports as % of Canadian net generation	0.60	-0.11	3.32
Net exports as % of U.S. generation	0.07	(0.02)	0.46
U.S. generation	1,068,327	1,214,365	1,740,000 <sup>e</sup>

<sup>e</sup> Estimated

Source: Statistics Canada  
Electric Power Statistics

The uranium industry reached its peak production in 1959 and then entered into a dramatic decline due to the loss of United States and United Kingdom markets (see Figure 1). Federal government action in establishing two successive uranium stockpiling programs prevented a complete collapse of the industry. The era of large commercial uranium sales began in 1966 and one quarter of presently known low-cost reserves are now under contract. The resource base is large and in no way limits foreseeable production and marketing plans. While the history of the uranium producing industry has been one of boom, recession and now difficult revival, the program of nuclear research and development has proceeded slowly but steadily and the CANDU reactor now appears successfully established and is attracting world attention.

Electrical energy gross generation in 1972 was 238 billion kWh, almost double the 1963 output (see Table 4). Over the years exports and imports have been more or less in balance but in 1972 exports totalled 10,372 million kWh, about four times imports. The net exports represent 3.3 per cent of total Canadian generation. While trade in electrical energy is small in relation to production, it is important in terms of the mutual benefits to be gained through interconnected systems. New high voltage direct current technology and large nuclear units will lead to increasing interconnections between provincial power systems.

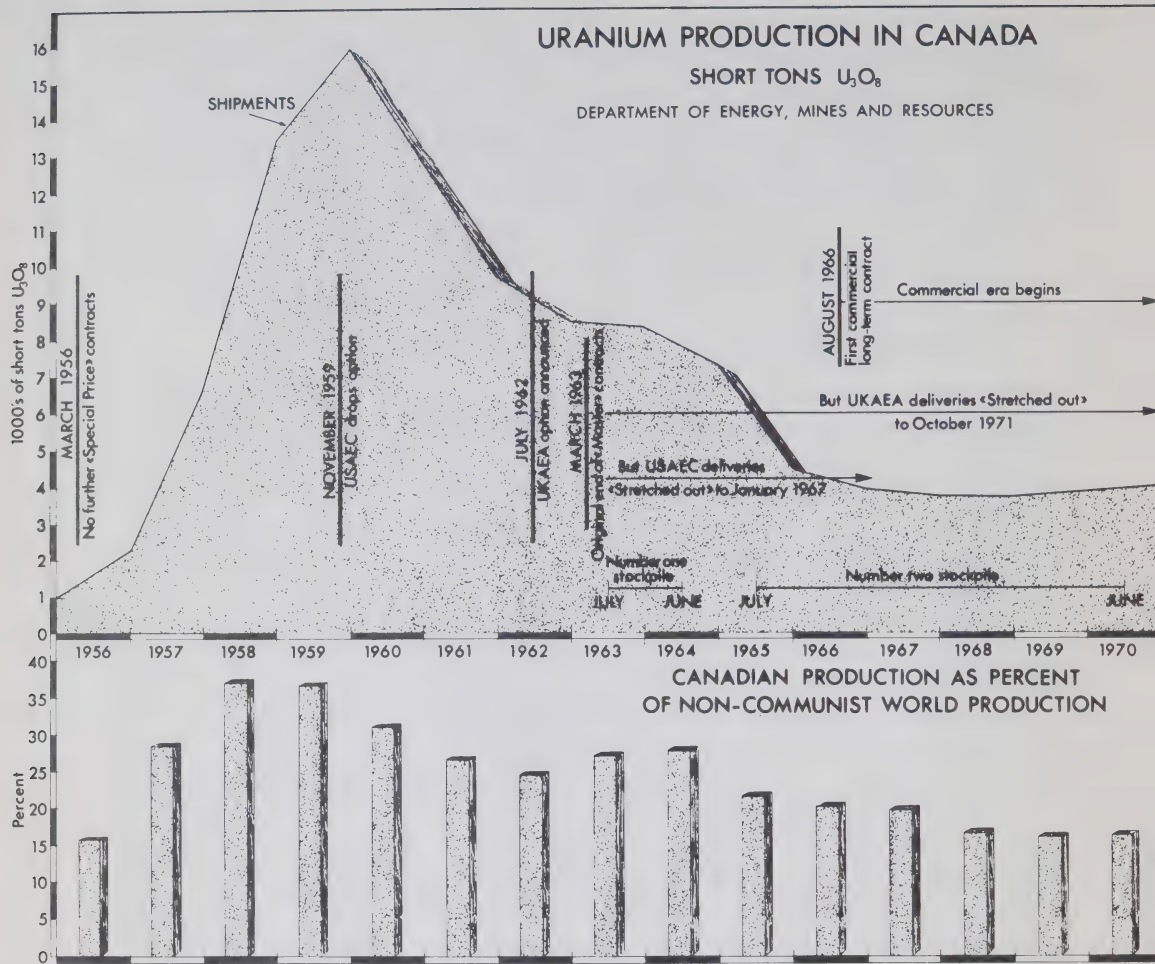


Figure 1

## FEDERAL ENERGY POLICIES

Energy in Canada has been moulded by detailed policies to meet unique Canadian conditions and needs. Our policies relating to energy are complex, diverse and incapable of simple formulation.

There are certain basic national objectives which have shaped the energy policies we have today. These objectives relate to adequate supplies of energy at competitive prices; the safeguarding of national security; the encouragement of energy resource development; the export of surplus energy supplies under terms that benefit the nation; the acquisition of energy supplies from abroad when they are more economic than domestic sources; and the alignment of energy policy objectives with other national objectives such as those relating to Canadian ownership and the protection of the natural environment.

Specific energy policies have been developed for each of the energy commodities and all of them should be subject to periodic review and assessment. Among the more important policies which presently exist and which now warrant re-examination are the National Oil Policy and the related concept of the Ottawa Valley line; the regulations governing the setting of royalties and land rights for oil and gas activity; natural gas marketing policy particularly in relation to exports; coal export policy, and also coal import policy particularly as it relates to the possibility of alternate domestic supplies to the Ontario market; uranium marketing policy in relation to market expectations of the late 1970's and 1980's; and the National Power Policy, particularly in relation to further development of a nation-wide power grid concept and the implications of current provincial government hydroelectric resource projects and nuclear power developments to this concept. There are a number of policies common to all energy sources requiring continuing examination, particularly those relating to fiscal incentives, Canadian ownership and further processing prior to export.

Federal and provincial responsibilities and interests in the energy field are intimately interrelated. No national policy can be contemplated without the fullest of intergovernmental consultations and consensus. Clearly the balance of priorities between energy producer and consumer needs, regional interests, Canada's international competitive position and domestic prices for consumer goods are among the major questions which the federal government must weigh in the national interest. The process of arriving at satisfactory policies cannot be rapid or without difficulty. But resolution of these problems through bilateral and possible multi-lateral discussion deserves the most sustained and determined effort.

### PRICE DEVELOPMENT OF FUELS

*(All prices and price increases in the report are expressed in constant 1972 dollars unless specifically noted).*

Canadian crude oil prices in the past have largely reflected U.S. crude price developments (see Figure 2). By the end of this decade both United States and Canadian crude oil prices may move towards parity with laid-down costs of foreign crude, and, barring government policies to insulate Canadian prices from outside influence, new sources of energy in Canada will then be developed on the basis of prices reflecting international price movements. Although international crude oil prices declined in the 1960's, the 1971 and subsequent agreements between the OPEC countries and the producing companies have already led to price increases and prices are expected to escalate through to 1985 with subsequently more moderate increases. In 1990 crude oil prices are forecast to be more than double today's prices.

Currently, natural gas is undervalued in most market territories when compared with competitive petroleum products. Gas from our frontier areas will cost much more. Greater flexibility in gas pricing is required if natural gas market values are to keep pace with increasing prices of competitive fuels. The cost of gas to distribution companies in 1990 could be more than twice current levels (see Figure 3).

Metallurgical coal prices will be influenced by international trends and the cost to Canadian consumers could be \$22-\$25 a ton by 1980 compared to \$19 today. As crude oil moves into the \$5 to \$7 a barrel range, coal liquefaction and gasification become feasible alternatives to conventional oil and gas. The cost of thermal coal will closely follow the cost of its oil and gas competition.

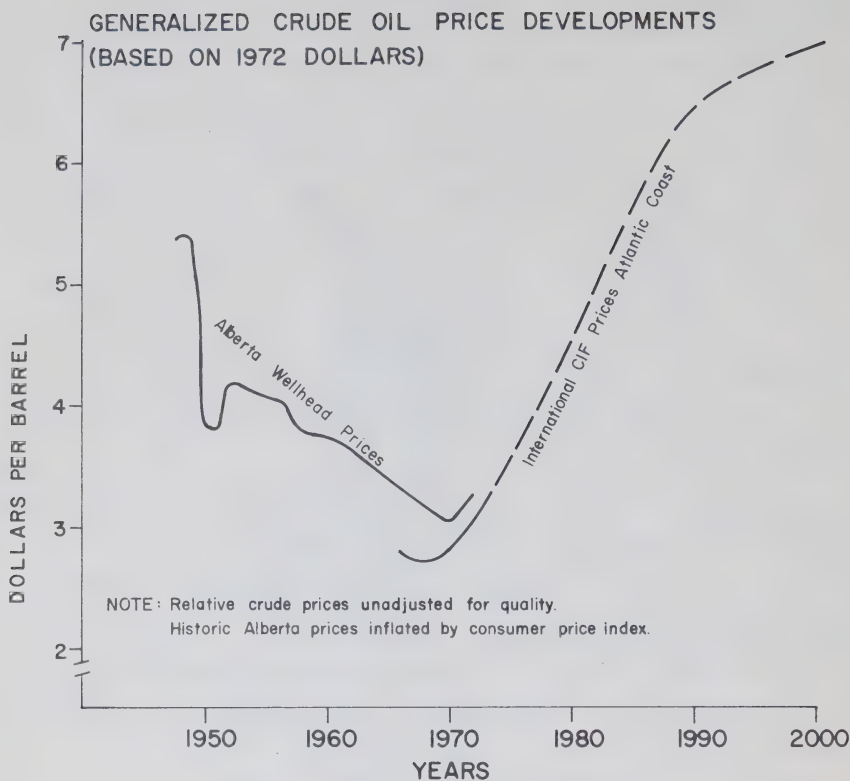


Figure 2

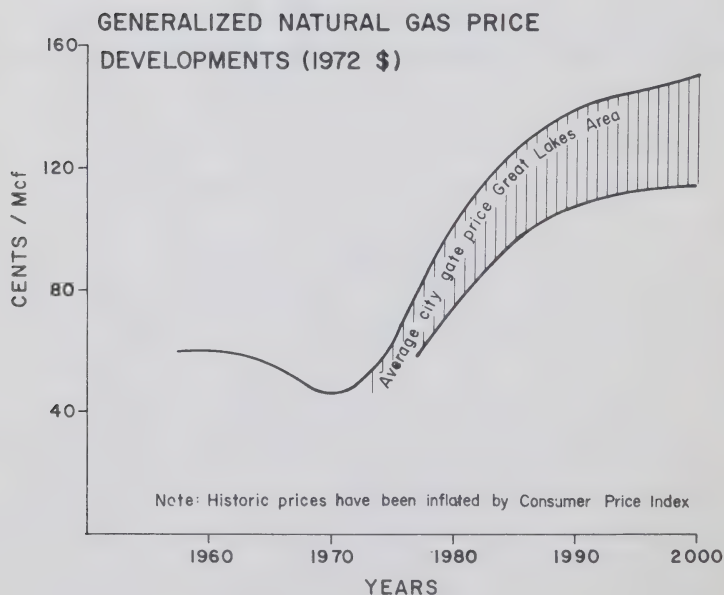


Figure 3

The current uranium ( $U_3O_8$ ) price is near \$6 a pound. By the year 2000 the price could rise to the point where it would be economic to recover some of those resources now delineated within the category of \$10 to \$15 per pound  $U_3O_8$ . As uranium costs account for only a small part of total nuclear power costs, however, a substantial uranium price increase could be accommodated with little impact on electricity production cost.

### CANADA'S ENERGY REQUIREMENTS

A forecast of Canada's future energy requirements and resource availability involves careful appraisals of future price expectations and of the trend of events in international resource availability as well as judgements on such matters as the impact of environmental standards. At best, the forecasting of energy demand and supply is a hazardous exercise but a continuing program of periodical review can improve the quality of forecasts.

Assuming no major changes in government policies or Canadian attitudes towards energy use or conservation, Canada's primary energy requirement by the year 2000 is likely to be more than four times that of today. Based on a population estimate of 35 million in the year 2000 our per capita energy consumption would be 2.7 times that of 1970. Only minor increases in the efficiency of energy use are assumed in this forecast. Increasing prices for energy commodities will tend to moderate demand growth rates in the long run.

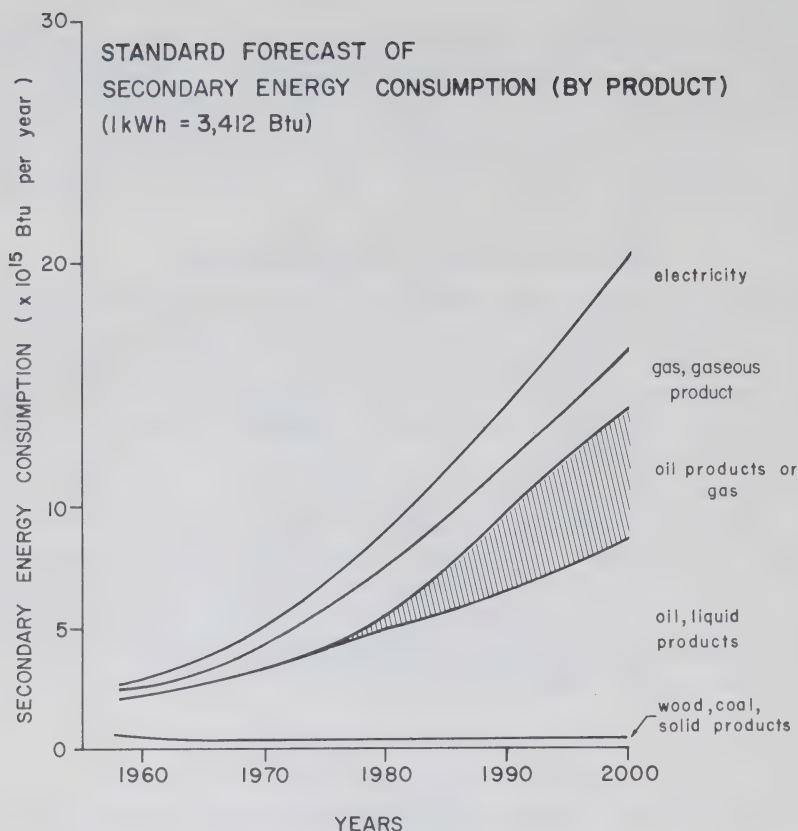
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TABLE 5  
STANDARD FORECAST OF CANADA'S SECONDARY ENERGY CONSUMPTION  
(10<sup>15</sup> Btu)

	1970	%	1980	1990	2000	%
Petroleum products.....	2.9	58	4.6-5.1	6.0-9.4	8.2-13.5	
Natural gas.....	1.1	22	2.5-2.0	5.4-2.0	7.7-2.4	79
Coal, coke.....	0.3	6	0.3	0.3	0.4	2
Electricity.....	0.7	14	1.4	2.4	3.9	19
Total.....	5.0	100	8.8	14.2	20.2	100

TABLE 6  
SOURCES OF ELECTRICITY GENERATION  
(Billions (10<sup>9</sup>) kWh)

Source	1970	1980	1990	2000
	%	%	%	%
Hydro.....	157 (76.5)	237 ( 60)	317 ( 44)	348 ( 29)
Thermal total.....	47 (23.5)	163 ( 40)	395 ( 56)	842 ( 71)
Coal.....	34 (17.0)	77 ( 19)	165 ( 23)	187 ( 16)
Oil.....	7 ( 3.5)	28 ( 7)	79 ( 11)	140 ( 12)
Natural gas...	5 ( 2.5)	12 ( 3)	11 ( 2)	15 ( 1)
Nuclear.....	1 ( 0.5)	46 ( 11)	140 ( 20)	500 ( 42)
Total.....	204 (100)	400 (100)	712 (100)	1190 (100)



*Figure 4*

The forms of energy used directly by the consumer (secondary energy) in the year 2000 will not differ markedly from today; petroleum and natural gas will probably still account for almost 80 per cent, coal will drop from 6 to 2 per cent and electricity will meet the remaining 18 to 20 per cent. These trends are shown on Table 5 and Figure 4. The sources of power for electricity generation, however, will change significantly (see Table 6). Hydroelectric power is expected to decline to 30 per cent of total electricity generation from 76 per cent in 1970 while nuclear power will increase to some 44 per cent from 0.5 per cent in 1970. Thus, by the end of the century, nuclear power will provide more than 8 per cent of our total secondary energy consumption compared to much less than 1 per cent today.

There is considerable uncertainty about future energy consumption patterns. Changes in life styles of Canadians, changes in the economic structure of the nation, and government policies relating to the environment or conservation can have an important impact on energy demand. The consumption forecast could be 15 per cent higher or 25 per cent lower than the standard forecast for the year 2000 depending on these factors. The range, as illustrated in Figure 5, could be even wider if economic growth or population levels are far different from standard projections.

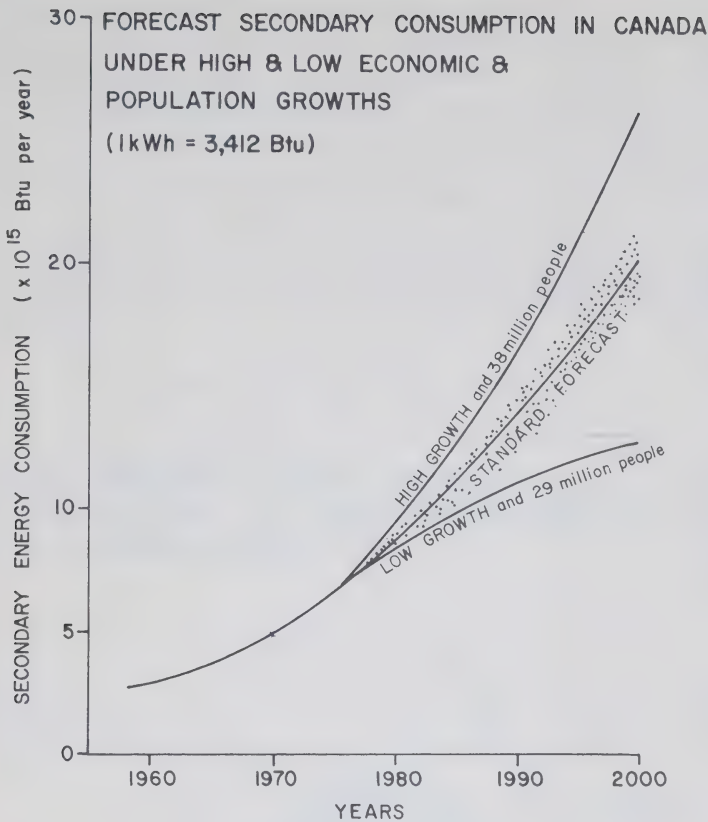


Figure 5

## CANADIAN RESOURCES

Known uranium resources are estimated to be 400,000 tons of  $U_3O_8$  available at prices up to \$15 per pound. Canada's cumulative domestic needs to the year 2000 could total 100,000 tons, while committed exports amount to some 60,000 tons. Thus Canada has a significant surplus over predicted requirements of low-to medium-cost uranium already proved or indicated. In addition there is estimated to be a further 500,000 tons of  $U_3O_8$  available at \$15 per pound or less. The cost of uranium plays only a minor role in the total cost of nuclear power: an increase in the cost of uranium from the present \$6 per pound to as high as \$50 per pound for example would only raise electricity costs from a CANDU reactor by 2 mills from the present 7 mills per kilowatt hour.

At best, hydroelectric energy production might double to about 310 billion kWh by 1990. Growth of this source will be moderated thereafter by competition from nuclear power.

Canada has extensive coal reserves estimated at about 120 billion tons of which about 118 billion tons are in British Columbia, Alberta and Saskatchewan. These are geological estimates of reserves in place, but even on the basis of economic mineability criteria, Canada has sufficient mineable coal for the foreseeable future,

TABLE 7  
CANADA'S OIL AND GAS RESOURCES

	In Place	Recoverable	Cumulative Production	Remaining
1. Proved Oil Reserves (Conventional) <sup>1</sup> 2 billion bbls.				
NWT.....	0.5	0.1	0.1	0.1
W. Canada.....	43.8	15.9	6.2	9.7
E. Canada.....	0.2	0.1	0.1	0.1
Subtotal.....	44.5	16.0	6.3	9.7
2. Proved Natural Gas Reserves <sup>2</sup> 3 trillion cu. ft.				
NWT.....	2.0	1.3	—	1.3
W. Canada.....	116.5	69.1	17.8	51.4
E. Canada.....	1.1	1.0	0.7	0.3
Subtotal.....	119.6	71.5	18.5	52.9
3. Potential Oil (Conventional) billion bbls.				
Arctic Islands and NWT.....		4 5		4 5
W. Canada (Provinces).....		70 — 28		70 — 28
East Coast.....		6 — 5		6 — 5
Subtotal.....		42 — 50		42 — 50
Subtotal.....		118 — 83		118 — 83
4. Potential Natural Gas, trillion cu. ft.				
Arctic Islands and NWT.....		4 5		4 — 5
W. Canada (Provinces).....		481 — 342		481 — 342
East Coast.....		101 — 44		101 — 44
Subtotal.....		253 — 326		253 — 326
Subtotal.....		835 — 712		835 — 712
5. Alberta Oil Sands <sup>6</sup> billion bbls.				
Open-Pit Mineable.....		65	0.1	65
“In-Situ” Recovery.....		236		236
Total.....	710.8	301	0.1	301
6. Alberta Heavy Oil <sup>7</sup> billion bbls.	75.0	30.0	—	30.0
7. Total Resource (BOE) billion bbls.		616 — 561	9.5	607 — 551

NOTE: Totals may not add due to rounding

FOOTNOTES TO TABLE 7.

- <sup>1</sup> Includes natural gas liquids.
- <sup>2</sup> Source: Canadian Petroleum Association (December 1972).
- <sup>3</sup> Figures quoted for "in place" gas are on a raw gas basis, all others are pipeline gas.
- <sup>4</sup> Geological Survey of Canada (February 1972) estimates of ultimate recoverable potential less proved reserves.
- <sup>5</sup> Geological Survey of Canada (March 1973) estimates of ultimate recoverable potential less proved reserves.
- <sup>6</sup> Source: Oil and Gas Conservation Board, "A Description and Reserve Estimate of The Oil Sands of Alberta", October 1963.
- <sup>7</sup> Source: "The Oil Sands of Alberta" — H. J. Webber, *The Journal of Canadian Petroleum Technology*, October-December 1967.

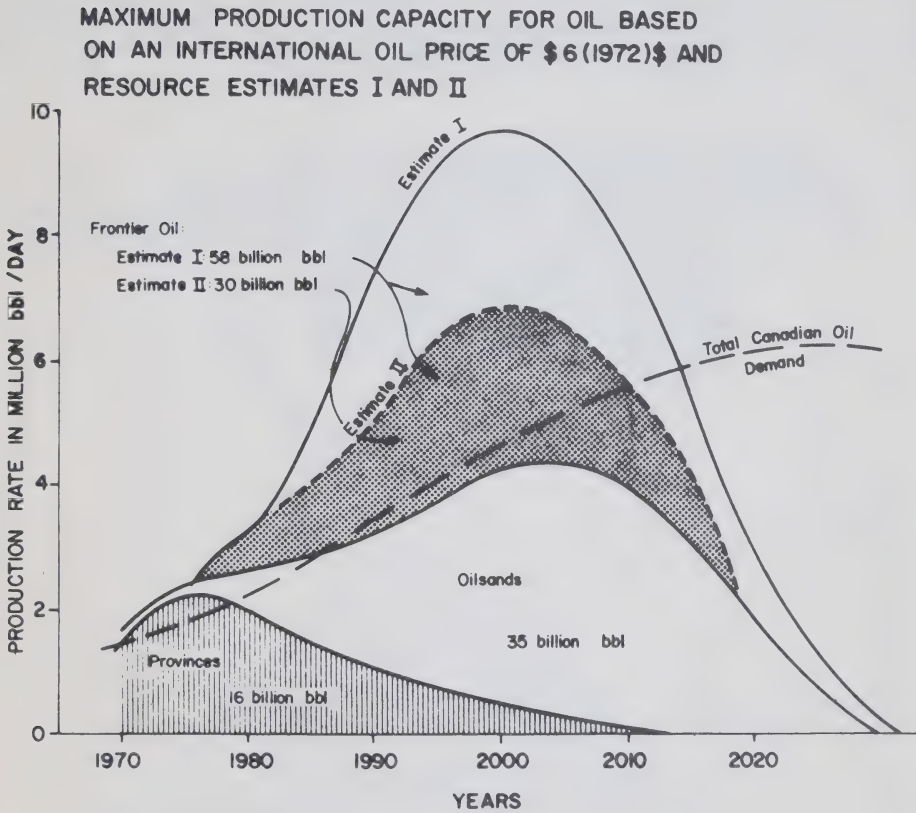


Figure 6

at substantially greater production levels. These reserves are almost all in Western Canada; most of the economic Maritime coal has been extracted.

In the case of oil and gas, there is a considerable uncertainty about how large the resource base actually is, as shown in Table 7. Most of the potential resources are expected to be found in Canada's as yet largely unexplored frontier areas.

Canada's estimated petroleum resource potential can be grouped into three categories: conventional oil, oil sands and heavy oils, and conventional natural gas. Estimates made by the federal government in 1972 (Estimate I) and 1973 (Estimate II) of potential recoverable conventional oil, are in the range of 118 to 83 billion barrels respectively; in addition, there is a remaining proved reserve of about 10 billion barrels. The Alberta oil sands are very large but present technology and foreseeable prices would restrict recovery to about 65 billion barrels. Heavy oils, primarily located in central eastern Alberta, could provide an additional 30 billion barrels. Proved natural gas reserves yet to be produced total 53 trillion cubic feet. Estimates of gas potential, based on the 1972 and 1973 assessments, range from 834 to 711 trillion cubic feet for Estimates I and II respectively.

Much of Canada's frontier oil and gas potential as well as oil sands and heavy oils will only become available at prices of \$6 per barrel and \$1.25 per thousand cubic feet (Mcf) or greater. Supply-demand studies, illustrated in Figures 6 and 7, indicated that at these price levels, and based upon either Estimate I or Estimate II of frontier potential, Canada has sufficient total oil and gas resource potential to meet domestic demand well beyond the year 2000.

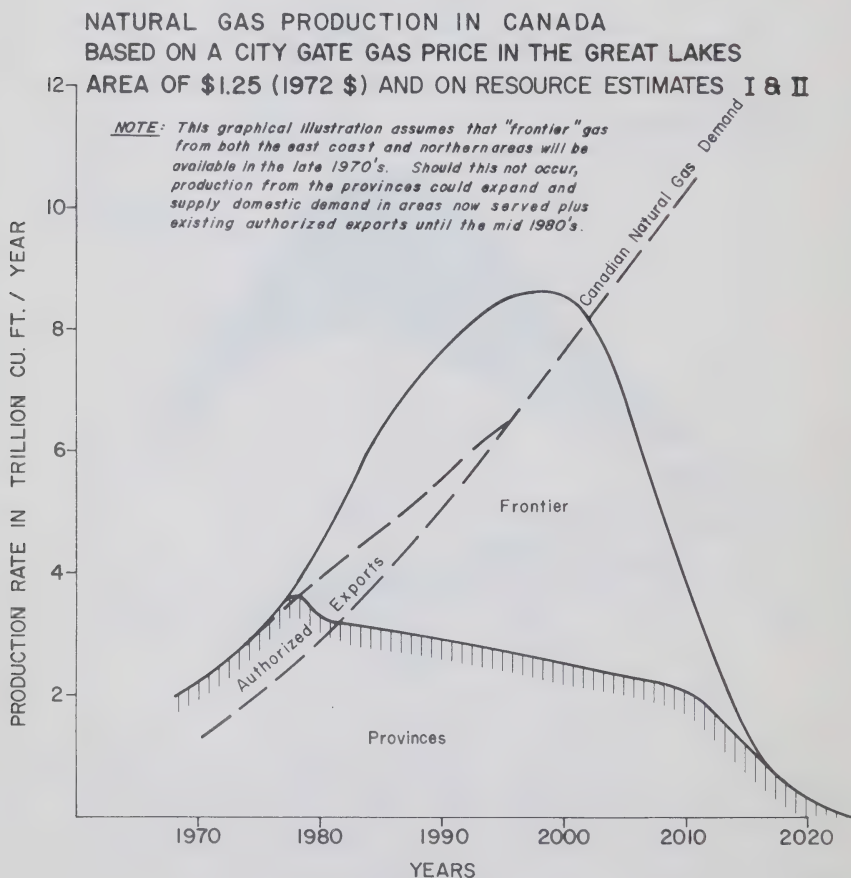


Figure 7

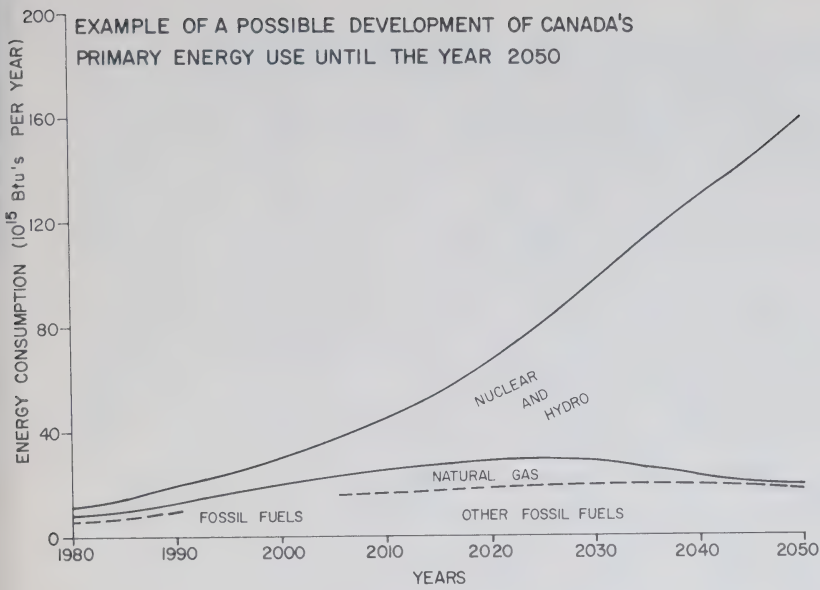


Figure 8

EXAMPLE OF A POSSIBLE DEVELOPMENT OF CANADA'S OIL PRODUCTION AND CONSUMPTION UNTIL 2050 BASED ON RESOURCE ESTIMATE II .

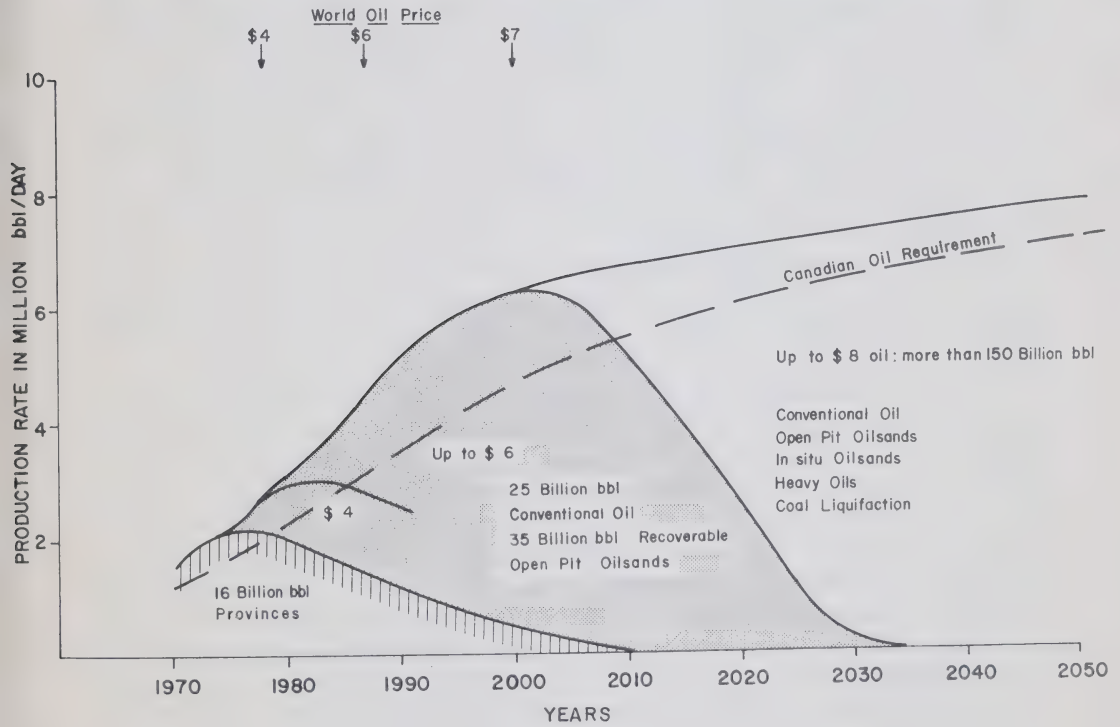


Figure 9

## A VERY LONG TERM SUPPLY-DEMAND PROJECTION

Illustrative projections through to the year 2050 show that electricity could provide about 90 per cent of all energy requirements by that time, as a result of a continuing development of the "electrical society" (see Figure 8). With an estimated population in 2050 of  $2\frac{1}{2}$  times that of today, the total amount of natural gas which would be needed to satisfy projected demands for that fuel over the intervening decades would be in the range of 500-600 trillion cubic feet. By the year 2050 natural gas may be replaced in all energy markets by electricity. Projections for oil (see Figure 9) suggest that Canada could satisfy her oil demand on the basis of Canadian conventional oil and oil sands mined by open-pit methods to beyond the year 2000; after that, oil sands developed by an "in-situ" technique and oil from coal would be required in addition to more costly conventional oil and open-pit oil sands. Thus, present indications of Canada's oil and gas potential suggest that there is probably more than enough energy resources to meet domestic requirements until at least the year 2050 with a possibility of substantial amounts of oil and gas being available for export. These forecasts are made on the basis of prices in the year 2000 which would not exceed 10 mills per kWh for electricity, about \$2 per thousand cubic feet for natural gas, and about \$7 or \$8 per barrel of oil (in 1972 dollars).

## INTER-ENERGY COMPETITION

The main document presents findings on studies of two areas of energy competition: competition among various energy sources to supply electricity, and the competition between fuel oil and natural gas. The findings are summarized below.

For Canada as a whole, competition in the area of fueling electrical generation will be such that it is unlikely natural gas will increase in use very far beyond its present levels while coal and fuel oil will still hold an important share of this market until at least 1985. Hydro power will continue to grow substantially until the James Bay and Nelson River projects and projects in British Columbia are finished, but after completion of such projects, only minor additions in terms of national capacity are anticipated. Consequently towards the year 1990 most of the growth of Canadian electrical consumption will be supplied by nuclear energy, assuming satisfactory progress is made regarding waste disposal problems. Only in Alberta and Saskatchewan could coal still be meeting a large share of the new generation needs.

Uranium costs account for only a small part of total nuclear power costs. A substantial uranium price increase could be accommodated, therefore, with little impact on nuclear electricity production cost. As illustrated in Figure 10, a uranium cost rise from its present \$6 per pound to as high as \$25 per pound would increase the cost of electrical power by only about 1 mill per kWh. Fossil fuel plants, on the other hand, are much more sensitive to fuel costs. For example, doubling the current approximate coal cost of 52¢ per million Btu would result in about a 50 per cent increase in electrical power cost (from about 8 to 12 mills/kWh) for a 75 per cent load factor 500 MW plant. As fossil fuel prices rise therefore, the trend toward nuclear generation will become more pronounced except in a few areas where transportation advantages help to maintain competitive fossil fuel prices.

To illustrate the effect of changing prices on the relative demand growth for oil and natural gas, the current and future industrial market for oil and natural gas in

COMPARISON BETWEEN TOTAL UNIT ENERGY COSTS (on the basis of 1972 \$) OF NUCLEAR POWER AND FOSSIL THERMAL POWER FOR 500 MW IN ONTARIO, FOR VARIOUS FUEL COSTS AND LOAD FACTORS, TAKING INTO ACCOUNT TRANSMISSION COSTS TO NEAREST LOAD CENTER AND RESERVES, IN 1972.

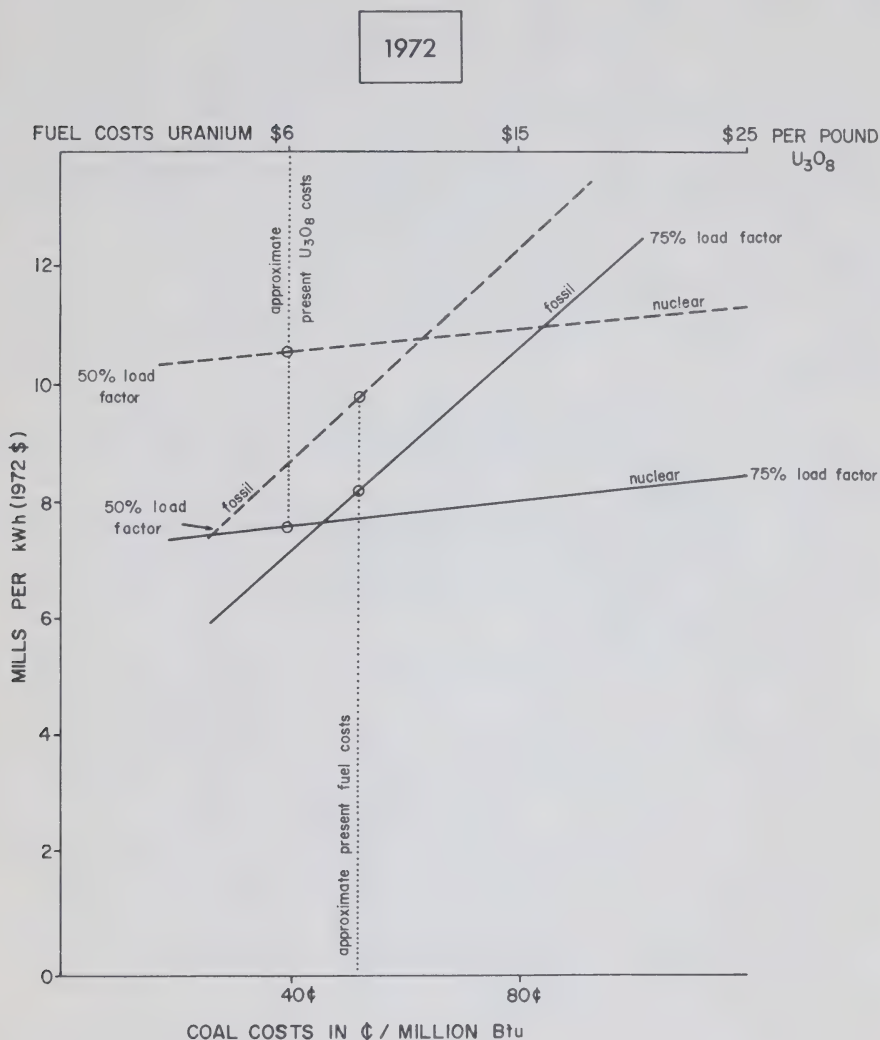


Figure 10

the Toronto-Hamilton area was analysed. The analyses show that natural gas has not been priced to take advantage of increased costs of heavy fuel oil in the industrial market. Given the current inflexibility in gas pricing and a rising price for petroleum products, the relative differences between oil and gas prices will continue to grow. Accordingly, natural gas prices to industry in this area could increase significantly and still maintain a large part of the existing and potential market. If gas prices and wellhead values are to reflect competitive market forces, a more flexible system of

gas pricing will have to be developed. Large volume sales of gas in western Europe and elsewhere in the world have recently been made by relating future contract prices to competitive fuel prices and other economic factors. The trend at present towards the establishment of more frequent redetermination periods for gas contracts indicates a movement in the same direction in Canada.

### SECURITY OF ENERGY SUPPLY

About 75 per cent of Canada's electrical energy is presently produced by domestic hydroelectric sources; more than one half of the remainder is generated from imported fuels. The imported fuels are used in Ontario and the Maritime Provinces; all other regions are self-sufficient on the basis of Canadian energy sources. Although Ontario electrical generation stations could be supplied by coal from Western Canada sources rather than from United States mines, a considerable economic penalty to the consuming utility would be involved on the basis of current costs. Strengthened electrical interconnections between the Maritime Provinces and Quebec could reduce the dependence of the Maritimes on imported oil for electrical generation.

CANDU nuclear power stations use Canadian uranium and over 80 per cent of the total material and equipment required for nuclear power facilities is available from Canadian sources. Self-sufficiency in electricity supply will increase as nuclear generation is expanded.

There are abundant supplies of metallurgical coal in Canada but transportation economics still dictate that Ontario steel mills be supplied from United States sources. Fifty-two per cent of this imported coal comes from mines owned by the Canadian steel companies.

Only about one half of the country's oil requirements is met from indigenous sources although there is a net surplus of oil supply on a trade balance basis. All regions east of the "Ottawa Valley line" are completely dependent on imports. In Eastern Canada, average stocks of oil are equivalent to about 40 days' requirements although at times available stocks would be somewhat higher. The degree of supply security could be improved by increasing stocks, extending Western Canada pipeline facilities to Eastern Canada, by working out international supply arrangements for times of emergency and by instituting a formal program of petroleum product rationing. Maintenance of the Ottawa Valley line in terms of the 1961 National Oil Policy protects Ontario's oil supply although with some economic penalty. Discovery of oil in commercial quantities off the east coast of Canada or in the eastern Arctic could reduce or remove the security of supply problem.

Continuous assessments of security of supply are proceeding. To date, the security threat has not appeared serious enough to justify the very costly arrangements of supplying the region east of the Ottawa Valley with western Canadian crude oil.

### CANADIAN ENERGY IN AN INTERNATIONAL CONTEXT

While Canada is self-sufficient in terms of energy production it does not have the potential to play a major role with regard to total North American needs. Our present exports to the United States meet less than 6 per cent of that country's oil and gas requirements (see Tables 8 and 9), but do play an important role in providing secure supply and in meeting a large portion of the needs of specific regional markets.

TABLE 8  
UNITED STATES PETROLEUM DEMAND AND IMPORTS FROM CANADA  
(millions of barrels per day)

	1965	1972 (est.)	1980	1985	2000
U.S. demand .....	11.5	16.1	20.9	25.0	35.6
Total U.S. imports .....	2.5	4.6	9.2	13.8	25.1
Imports from Canada .....	0.3	1.0	0-1.8	0-2.5	0-4.5
Imports from Canada as a % of total imports	12.0	21.8	0-20	0-18	0-18
Imports from Canada as a % of total U.S. demand .....	2.6	6.2	0-8.6	0-10.0	0-12.6

TABLE 9  
UNITED STATES NATURAL GAS DEMAND AND IMPORTS FROM CANADA  
(trillion cu. ft./year)

	1965	1972 (est.)	1980	1985	2000
U.S. demand .....	15.6	23.9	26.2	27.5	33.0
Imports from Canada .....	0.4	1.0	1.0-2.0	0.9-3.0	0-4.0
Imports from Canada as % of total U.S. demand .....	2.6	4.2	3.8-7.6	3.2-10.8	0-12.1

Future oil and gas exports from Canada to the United States or to new export markets will depend heavily on the success of frontier oil exploration and new production technology for the oil sands. Conceivably Canada's contribution to total U.S. oil and gas needs in the year 2000 could range from zero to 12 per cent. Canada is dependent on the United States for about 20 million tons of coal imports for Ontario needs. Over the years, the two nations have been more or less in balance on electrical energy trade. In 1972 there was a net electrical energy export from Canada equal to 3.3 per cent of total Canadian generation which represented about one half of 1 per cent of United States needs.

The average export price for natural gas of about 30¢ per thousand cubic feet appears to be very low in relation to the rising price structure in the United States. However, if Canada wishes to insulate its domestic market from gas and oil price increases, some price control mechanism is necessary.

Although Canada has an adequate oil, gas, coal and uranium resource base in respect of its own foreseeable domestic requirements, our resources are not large in relation to total world resources and needs. For instance, oil shales and oil sands around the world contain more than 100 times the oil stored in our oil sands and these new international sources will begin to become available well before the end of the century as prices rise significantly. We are fortunate in having an assured energy resource self-sufficiency for a long period into the future, but Canada's future role as a world energy source will not be significant.

### THE RATE OF RESOURCE DEVELOPMENT

The rate of development of our energy resources will be determined by the extent to which Canada wishes to meet export demands as well as domestic needs. It will also be affected by judgements as to the benefits that would accrue to Canada from alternate rates of development.

The "expected" rate of resource development would result if free market forces were allowed to operate within the existing framework of government action or

influence. If the expectations about price developments and the Canadian resource base are approximately right, Canada could "expect" a rather high rate of resource development.

The "desired" rate of energy resource development could be higher or lower than the expected rate of resource development, depending on economic and political considerations which relate to national goals such as regional development, full employment, economic growth, environmental protection, resource adequacy, reasonable price stability, a favourable balance of payments, and an equitable distribution of rising incomes. Thus the appropriate or desired rate of development cannot be determined by considerations related to energy policy alone. It should be recognized, too, that the desired rate of resource development will change over time as economic and political attitudes evolve.

The "actual" rate of resource development will be determined by the success of the government in actually influencing the course of events. If the expected rate of development is thought to be either too high or too low, the government could endeavour to moderate or accelerate the pace by utilizing a mix of policy instruments. However, having regard to the difficulty of projecting what the "expected" rate of development will be, and to economic and political imponderables associated with defining the "desired" rate, as well as the lag in the application of the policy instruments, it is unlikely that the government could ever hope to fine-tune the short-term rate of development. With careful policy planning, however, it should be able to bring the long-term rate of energy development close to the desired rate.

## ECONOMIC RENT FROM CANADA'S OIL AND NATURAL GAS RESOURCES

Production from oil and gas fields must furnish the industry with sufficient earnings to reimburse non-successful exploration expenditures and cover all the costs of the producing operation including depreciation, field operating expenses, overhead, transportation costs and an adequate return on risk capital. Revenues in excess of this amount are defined as "economic rent" and may accrue to either the industry or the owner of the resource, usually the government.

There are two different approaches by which Canada could obtain the benefits of economic rent. It could be collected by government in the form of royalties, taxes and bonus payments, or it could be realized by energy consumers in Canada by allowing them to benefit from low energy prices.

Both systems have their inadequacies. Rent collection by government through royalties applies only to the production stage, omitting possible revenues from the transportation, refining and marketing activities. In addition, the benefit of the rent collected in this manner is not readily apparent to end consumers of energy in Canada. To be fully effective and to deter inefficient or wasteful use of energy, controls on oil and gas prices would have to apply not only at the wellhead but also on a selective basis to a whole range of refined oil products.

The existing economic rent collection system for potential production from federal lands in Canada is not sufficiently flexible to be efficient under a variety of different cost conditions. While there are provisions to adjust royalties downwards to encourage production from small to medium size oil and gas pools with low well productivity, the present system would leave too much rent in the hands of the industry in the event of prolific discoveries and highly profitable operations.

Comparison of Canada's fiscal terms—taxes and royalties—with those existing in other countries is not a very meaningful or useful exercise. Development costs and market conditions are very different throughout the world and appropriate fiscal terms in Canada must be designed to reflect the widely ranging economic nature of our resource base and the stage of current development.

A detailed review of Canada's present economic rent collection system is necessary if the country is to realize full benefits from the development of its frontier resources.

## ENERGY AND EMPLOYMENT

Four aspects of employment relative to the energy industries are examined in the main document in a preliminary way: direct employment, indirect and induced employment, regional employment, and the long-term development of Canada's labour force. Although further work in this important area of employment generated by energy industry activity is required, sufficient research has been done to indicate that important multiplier effects arise throughout the economy from all aspects of energy industry activity. In particular, the regional benefits of activities of the energy industry warrant careful attention as this industry offers employment benefits in areas where other industrial opportunities may be limited. Employment benefits cannot be adequately assessed on the basis of a national average. Consideration should be given to development of major projects ahead of a domestic need if that will assist a more orderly use of Canadian manpower and manufacturing potential and still be consistent with other government objectives. Canada's labour force is not expected to expand as rapidly in the 80's as it has recently and therefore, major energy projects in the 80's could exert greater pressures on the economy than is now the case.

## THE ROLE OF ENERGY COSTS IN CANADIAN INDUSTRY

On the assumption that international oil and gas prices will increase in the future, and Canadian prices are allowed to parallel those increases, it is important to know which industrial sectors will be influenced and to what extent their competitive positions will be affected. Higher energy costs could place some Canadian industries in a difficult position. In the aggregate, these industries account for about 1 per cent of Canada's real domestic product and 3 per cent of Canada's industrial production (see Table 10). These industries are essentially those that use natural gas extensively, such as the chemical industries that have to compete with similar industries operating in the United States Gulf Coast area using cheap natural gas feedstock. Increased prices would also create problems for a further group of industries which produces in aggregate about 10 per cent of the real domestic product and 30 per cent of Canada's industrial production. Some of these industries play a vital role in regional economic development. Attention may have to be given in the short term to ensure that some important Canadian industries such as pulp and paper and chemicals can accommodate to new price levels. There should, however, be no problem with the physical availability of natural gas to industrial consumers in Canada whereas the projected "gas gap" in the United States suggests that over the long term the availability of new gas supplies rather than cost may become the overriding concern in that country.

TABLE 10  
LARGEST DIRECT AND INDIRECT ENERGY USERS

Industry	% Contribution to Real Domestic Product (1961)	Energy Required per Dollar of Final Demand	
		Direct and Indirect (¢)	Fuels Only (¢)
Other chemical industries.....	0.92	19.4	13.7
Asphalt roofing.....	0.05	16.9	14.3
Cement and lime manufacturing.....	0.20	16.2	9.9
Iron and steel mills.....	1.00	14.7	10.7
Plastic resin manufacturing.....	0.13	13.8	9.8
AO. non-metal mines.....	0.52	12.5	9.2
Agriculture.....	4.53	12.4	10.7
Other non-metal minerals.....	0.07	12.1	4.2
Paint and varnish.....	0.15	11.7	9.3
Vegetable oil mills.....	0.02	11.6	9.5
Pulp and paper mills.....	2.18	11.5	4.9
Clay, stone and refractory.....	0.12	11.3	6.9
Leaf tobacco processing.....	0.02	11.0	9.3
Dairy factories.....	0.48	10.9	8.9
Steel pipe and tube.....	0.12	10.4	7.0
Flour mills.....	0.06	10.2	8.1
Other wood industries.....	0.11	10.0	8.0
Meat processing.....	0.48	9.7	7.9
Total.....	11.16%		

### UP-GRADING OF ENERGY EXPORTS

There are six realistic opportunities for up-grading energy exports: uranium enrichment, the export of nuclear energy as electricity from CANDU reactors using Canadian uranium, coal gasification, export of oil products rather than crude oil, the export of synthetic natural gas rather than oil products, and export of petrochemicals rather than oil products or natural gas. The construction of a uranium enrichment plant and the export of nuclear energy to the United States, are possibilities which require a decision on the part of Canadians on the question of using Canadian electrical energy to meet the power needs of other nations. Similarly, the environmental consequences of all of these possibilities must be balanced with the possible economic gains. A move towards exporting large volumes of refined petroleum products from western Canadian production would require industry cooperation in refinery construction and an interference with crude oil trade between affiliated companies.

### SCIENCE AND TECHNOLOGY IN ENERGY POLICY

It is important that research and development projects specific to Canada's needs be selected and that strong measures be taken to ensure that facilities, personnel and funds are available to support these activities at an adequate level within Canada. This in turn will lead to greater participation by the service and manufacturing industries in the major projects required to meet Canada's energy requirements.

The initial priorities for energy research and development must be addressed to fossil fuels as these are the resources which Canada will rely upon to carry it through this century into the age of nuclear fusion and other "advanced" technologies.

Among the most important areas are the Athabasca oil sands, and other heavy oil deposits in Western Canada; and the development of techniques and equipment to permit the efficient and safe exploration, production and transportation of the oil and gas resources from the Arctic landmass, from the ice-infested Arctic offshore areas, and from the sedimentary basins off the east and west coast.

Other important areas for research and technological development include:

- improvements to the CANDU reactor system;
- resolution of heavy water production problems;
- development of better and more economical methods of avoiding or controlling undesired effects on the environment;
- more efficient means of producing and utilizing energy, including the potential of Canada's large coal reserves;
- lower cost and more efficient electrical energy transmission and storage systems;
- energy resource inventory appraisals.

## STATE PARTICIPATION IN THE CANADIAN ENERGY INDUSTRY

The role of government in energy matters in Canada will grow because of the traditional government role in electrical energy which will constitute an increasing share of energy supply in the future.

The Canadian nuclear generation program in the form of the CANDU reactor is further evidence of the prominence of state participation and the importance of this influence will increase inasmuch as 44 per cent of total electrical generation by the year 2000 will be from nuclear, compared with less than 3 per cent in 1972. The most extensive degree of federal government participation in the energy industries occurs in the uranium and nuclear industries. The government participates in all phases from exploration and mining to nuclear plant design and operation.

Much of the Canadian coal industry is in private investment hands. Foreign investors control 73 per cent of coal mining now being conducted in Canada. The concentration of the industry into the hands of the large corporations is a result of the large financial and technical challenges which must be met. There is federal participation in the Cape Breton coal mines, but this was brought about to meet social objectives relating to the maintenance of established communities and the diversification of the local economy. The question of state participation in Western Canada revolves primarily around the Dominion Coal Blocks and whether they should be opened up to the export market or conserved for future domestic use. The case for government participation in the coal industry is based largely on the value to the federal government of having working insights into coal industry operation having regard to the growth potential of the coal resource base.

The proportion of state-held investment in the Canadian petroleum industry is less than 1 per cent and lies largely in the federal government's participation in Panarctic Oils Ltd. and the Quebec Government's investment in Société Québécoise d'initiatives pétrolière (SOQUIP).

A "national petroleum company" (NPC) would provide a vehicle by which the government could seek to obtain better knowledge of the domestic and international petroleum industries thereby providing legislators with more valid law-making insights. An NPC could act to stimulate regional development in specific areas of Canada. It could serve as a centre for Canadian research, concentrating on unique Canadian opportunities and on the potential spin-offs in industrial activity. It could play a role in determining the criteria on which the government might base its policies regarding economic rent collection. It might also play an effective role on behalf of government in relations with other countries where their state companies were active. It could assist in the development of "headquarters" activities in Canada.

The decision by government to participate more extensively than at present in the energy industries rests largely on the question of whether such a decision should be based solely on economic criteria or whether government should become involved — for reasons which will accept lesser results on the commercial side for more beneficial results in terms of the development of the Canadian political community.

It may be, however, that to a large degree, the benefits of state participation in the petroleum industry could be realized by means already at hand and there is no discernible void to be filled in Canada by the formation of an NPC. Furthermore it can be argued that formation of such a company would serve as a cautionary signal to foreign-controlled companies thus initiating a slowdown of investment in Canada's oil and gas industry which could result in an eventual overall net cost to the Canadian taxpayer or energy consumer. With much of the most promising acreage already under permit or lease and with the already existing overabundance of service station outlets, to quote but two examples, it is probable that such a company could only be formed and become viable within a reasonable time horizon by buying-out or acquiring ongoing operations in each industry segment: exploration and production, transportation, refining and marketing. The cost of such an entry strategy would be high and would have to be borne initially by the taxpayer in the form of foregone revenues or high initial capital outlays, either of which would result in an increased tax burden. The justification for the formation of such a company, by definition would be mainly on other than economic grounds. The multiplicity of goals and objectives would almost certainly insure that any NPC would be commercially less efficient.

## ENERGY DEVELOPMENT—THE IMPACT ON CANADA'S ECONOMY

An important policy question relates to whether energy resources which may be surplus to Canadian needs should be developed for export to what appears to be an insatiable U.S. and world market. The implications are fundamental to Canada's long-term economic strategy. A comprehensive answer should ideally be based on a wide range of analyses including the economic impact of both the investment and the operation phases of energy development, as well as on the possibility and impact

of alternative developments in other sectors of the economy. The scope of the studies reported on in the main document are, at this point in time, more limited. The economic impact of the investment phase and the implied large resource allocation to the energy economy is analysed. Implications of both the investment phase and some of the more important longer-term considerations were treated in a conceptual way.

Possible investment in energy development during the balance of this decade ranges from \$42 billion to \$68 billion. Five illustrative investment scenarios have been chosen for study purposes. In simplified terms the major differences are:

No Northern Development: (A) "Self-sufficiency"	requiring \$42 billion in investment
Mackenzie gas pipeline starting in 1975 : (B) "Standard Development"	requiring \$50 billion in investment
Mackenzie gas and oil pipelines : (C) "Extensive Development"	requiring \$60 billion in investment
The above plus a gas pipeline from the Arctic Islands : (D) "Maximum Development"	requiring \$68 billion in investment
Case B but with development of Mackenzie gas pipeline in 1977 : (E) "Delayed Development"	requiring \$49 billion in investment

The last four cases assume varying degrees of oil export above what would balance our expected imports. The "Self-sufficiency" option assumes no new natural gas exports and balances oil imports and exports.

The economic impacts of the five possible expenditure programs have been measured by using an econometric model and complemented by qualitative discussion. The "Standard" and "Delayed" development cases, both costing about \$50 billion could be absorbed by the Canadian economy without a major upheaval. In an underutilized economic environment, there would be considerable benefits associated with this investment spending in terms of gains in employment and income. The "costs", such as price and exchange rate pressure would not be excessive and would be of short duration. Under tight market conditions the potential gains would be less. Viewed from the capital resource requirements of these cases, the priorities of our society would not have to be rearranged to accommodate them.

The three remaining cases range from a \$42 billion Canadian "Self-sufficiency" case through a \$60 billion "Extensive Development" to a \$68 billion "Maximum Development" case. All three, albeit in different ways, would influence considerably the structure of Canada's economy and could involve the rearrangement of socio-economic objectives.

The "Self-sufficiency" case could indicate a choice by Canadians to forego income generation from resource development and call on these resources at a pace dictated by domestic demand. It would result in the release of scarce capital resources for other activities.

The "Extensive" and "Maximum Development" cases would endeavour to maximize income from resource development and in so doing could create severe pressures on prices and on the available productive facilities. The adoption of these programs would have to be accompanied by stringent monetary and fiscal restraints and would involve a reordering of economic and social priorities.

## THE EXTENT OF FOREIGN OWNERSHIP AND CONTROL

Of the \$31.4 billion of assets employed in the Canadian energy industries at the end of 1970, \$11.0 billion or 35.1 per cent was controlled by non-residents, and \$9.8 billion of this was concentrated in the petroleum industry.

The petroleum industry (exploration, production, refining and distribution) is dominated by foreign controlled firms which account for over 91 per cent of the assets and over 95 per cent of the sales of the industry. About four fifths of the non-resident controlled assets are held by United States interests.

The current level of foreign control in the coal industry is about 73 per cent and reflects recent developments in western export-oriented metallurgical coal development.

The uranium industry has a mix of public and private ownership, with over 20 per cent of the assets under foreign control.

The most important source of funds for the petroleum industry is internal cash generation. Internal sources of funds tend to account for an even larger proportion of the capital of the foreign controlled firms than of the Canadian controlled sector of the industry. For the period 1961-1970, 66 per cent of the capital for the industry came from internal sources. Of the sources external to the firm, 35 per cent was drawn from Canadian sources. Approximately 23 per cent of total financing was derived from foreign sources.

Most territory which is expected to yield new oil and gas reserves is already under permit to firms doing exploration. Canadian controlled firms only hold the rights to about 15 per cent of federal and provincial permits and leases.

The market dominance achieved by many of the foreign firms makes it difficult for smaller and newer firms to gain a foothold. The vertically integrated structure of the largest firms in the petroleum industry permits them a kind of flexibility of access to capital reserves to meet the large capital needs, which a less integrated Canadian firm would have great difficulty challenging. The National Oil Policy, which divides Canada into two marketing regions, has also affected the capacity of independent non-integrated firms to compete.

The desire of Canadians for rapid development, frequently beyond the immediate capacity or preparedness of Canadian firms to undertake, and the interest and capacity of foreign petroleum companies to undertake these projects have made for high levels of foreign control in this sector.

Foreign governments, especially the United States, have encouraged their companies to work outside the country through beneficial tax policies and Canadian governments have been receptive to such investment.

## THE IMPACT OF FOREIGN CONTROL

Because of the importance of the petroleum industry within the energy sector of the economy and the dominance of foreign control in that industry, the discussion focuses primarily on petroleum.

Foreign investment has and does involve advantages for Canada in the development of its energy resources. The development of activity and employment in these industries would likely not have been as rapid in its absence. Productivity might be advanced through access to superior technology and efficient management. However, Canada might not always be realizing the full potential benefits from energy investments — and this may be due in part to the high level of foreign control in some areas.

Foreign controlled operations could contribute more to Canadian economic activity if more goods and services were procured locally, if more R&D were done in Canada, and a greater degree of further processing were completed within the country. The international allocative process of the multinational enterprise may not be according Canada maximum opportunities in these respects. Prices set for non-arms-length transactions on large volumes of international trade can affect Canadian tax revenues. The structure of industry in Canada is also affected by the dominance of large foreign-controlled firms.

In terms of Canada's overall balance of payments and trade position, the oil and gas industry is an important factor.

In 1970 oil and gas exports amounted to almost 6 per cent of total exports, while imports by this sector accounted for 4 per cent of total imports. These relative proportions have reversed from their 1965 levels, thereby reflecting the contribution of this sector to Canada's increasing trade surpluses.

In terms of importance, the impact on Canada's capital account is perhaps the largest. Of the total foreign direct investments in Canada in 1970, the oil and gas industry accounted for almost 30 per cent, while only accounting for 12 per cent of the outflow due to direct investment overseas. Taking all the transactions for the oil and gas industry on the capital account, the industry accounted for an average of 34 per cent of the balance in the years 1965-1969.

In the period 1965-1968, the sectoral balance of payments was in approximate balance with capital inflows offsetting the deficit on the current account. After 1968 the sectoral balance of payments began to show substantial surpluses which, by 1970, amounted to about \$350 million due mostly to the sharply rising trade surplus resulting from crude oil export growth.

The significance of foreign control on these international transactions and payments positions is difficult to assess. The transactions involved are large but the adjustments posed for balance of payments by this industry would not appear to turn largely on the nationality of the owners. The heavy reliance on foreign direct investment in this sector would suggest that the general balance of payments trends and their timing would have been different in its absence.

Aside from the economic and industrial aspects of foreign control, there are other concerns relating to the impact of high levels of foreign control on Canada's ability to determine its own priorities, and to control its environment.

## EXISTING FOREIGN CONTROL POLICIES

Canada has a number of laws and regulations, at both provincial and federal levels, which influence the role of foreign-owned and controlled companies active in the energy industries. These include the proposed Foreign Investment Review Act; National Energy Board Act; functions of the Resource Management and Conservation Branch of the Department of Energy, Mines and Resources, and the Northern Natural Resources and Environmental Branch of the Department of Indian Affairs and Northern Resources; recent revisions of the Tax Act; restrictions relative to foreign ownership of uranium; and the Atomic Energy Control Act.

In addition, the federal government's role in Panarctic Oils Limited is an example of a direct government initiative which furthers domestic ownership as does the establishment of the Canada Development Corporation by a special Act of Parliament to ". . . help develop and maintain strong Canadian-controlled and managed corporations in the private sector of the economy and . . . give Canadians greater opportunity to invest and participate in the economic development of Canada".

## FUTURE OPTIONS REGARDING FOREIGN CONTROL

Foreign investment is not the sole, nor perhaps the most important cause of any concerns related to Canada's realization of maximum benefits from the energy sector. Foreign direct investment does, however, involve a variety of potential costs and benefits for Canada. As a result, no single policy can be expected to remove all concerns relating to foreign investment in the energy industries.

Many of the elements of an energy policy would alter the mix and magnitude of the benefits which Canada realizes from foreign investment in this sector. Any further initiatives on the issue of foreign investment must furthermore be compatible with Canada's industrial goals, international objectives and objectives in federal-provincial relations.

Some of the "gaps" which exist in Canadian capacities to undertake some projects and that can therefore be considered as contributing factors in the level and nature of foreign investment, may best be dealt with through general economic or industrial policies.

Changes in general industrial and energy policies are not, however, able to influence some of the factors which affect international investment and the way it operates in Canada because some of these are rooted in institutions and policies outside of Canada. Furthermore, some general policy approaches may not permit the realization of the benefits of foreign investment while reducing its disadvantages.

A variety of policy approaches have been suggested in public discussions and should be tested as to their advantages and disadvantages in dealing with foreign investment in the energy sector. These include:

Canadian participation in the equity of all firms — e.g. 51 per cent Canadian ownership in the equity of all energy companies, or of any new ventures.

Joint ventures involving Canadian partners — public or private.

Carried interest rights for a public authority leading to "participation" in the firms involved.

Public ownership of a firm in this set of industries.

More extensive use of a review procedure in the investment made in the energy sector.

## CANADIAN ATTITUDES TOWARDS ENERGY

Our attitudes towards energy are unique for a northern nation. We have chosen not to be frugal in our use of energy, but to use it liberally to enable us to develop life styles similar in many ways to those of warmer, more densely populated industrialized countries. We aspire to the benefits of both urban and rural living with large living quarters with ample space around our homes, our cities occupy a much larger surface area than the cities with equivalent population in most other nations, we expect as a matter of course to have a high degree of personal mobility and local and long distance communication, and many Canadians enjoy at times the use of a summer cottage or a winter cabin. This attitude toward life takes for granted the availability of ample energy, and it uses large quantities of energy to overcome the problems associated with our rigorous climate, large land area, and relatively dispersed population. Our energy policies must take into account these attitudes and their economic and social implications.

A distinctive situation in Canadian life relates to the change of life pattern of native Indians and Eskimos consequent upon the introduction of a high-energy technology and its associated economic and social system. Much of the potential for future energy resources lies in areas where the life styles of native peoples could be strongly affected, but where development of energy resources offers the principal hope for economic prosperity in the near future. Energy policies will have important social and cultural, as well as economic and environmental consequences in the hinterland of Canada.

## ENERGY AND THE NATURAL ENVIRONMENT

Most Canadians agree on the desirability of maintaining a clean and healthy natural environment. There is increasing concern about the deterioration of the quality of the environment in many parts of Canada. The production and use of energy have contributed to this deterioration. However, with adequate environmental awareness and knowledge, it is possible through selection and design of processes and equipment, and proper technology and operating procedures, to produce and use adequate energy for present and foreseeable future requirements, and at the same time improve the quality of the natural environment and maintain it at an acceptable level.

The cost of improving the quality of the environment where it has been adversely affected by energy activities, and of maintaining the quality in all parts of Canada at a level up to or above the acceptable national objectives, against undesired effects of energy activities while still producing and using energy in the amounts anticipated for the period 1974-1983, has been estimated to be in the range \$7 billion to \$10 billion. Such a cost would add 5 to 7 per cent to the estimated total cost of energy production and use during the decade. About two thirds of the additional cost would be incurred in connection with the use of energy in transportation.

It therefore appears that the cost of environmental protection itself will not be likely to have an important effect on the national economy, or cause a significant change in the pattern of energy use.

Canada has an international responsibility to contribute to the solution of global environmental problems arising from the use of energy, and to finding ways for national needs for energy to be met without adding to the environmental problems of other nations or future generations.

Action needed to increase the effectiveness and economy of environmental protection and resource use while ensuring adequate energy for Canadians now and in the future includes:

- Continuing review and revision of federal and provincial environmental regulations applicable to energy activities;
- Research into Canadian environments and ecosystems and the effect on them of energy activities;
- Research and development of methods of avoiding or lessening the undesired effects on the environment of energy activities;
- “Before” and “after” studies of the environment in typical energy developments;
- The formulation and implementation of effective programs of land-use and for use of aquatic and marine areas;
- Identification of areas or environments of particular sensitivity to disturbance;
- Public release of information on the environmental implications of the production and use of various forms of energy and various fuels;
- Cooperation and exchange of information with industry and other countries on the environment and the effect of energy activities;
- The development and strengthening of effective international environmental law.



